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Appl. No. 09/802,443

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Remarks

Claims 1, 8 and 11 are amended herein, and claim 20 is newly added. No new matter is introduced by any of the amendments, and entry thereof is requested.

It is noted that all of the claims in the application as originally filed (claims 1 - 19) were considered in the December 4, 2002 Office action, notwithstanding a Restriction Requirement mailed May 19, 2002. The Restriction requirement has apparently been withdrawn, although the December 4, 2002 Office action does not expressly so state. Applicants' Election filed June 28, 2002 is accordingly rendered moot.

Claims 1 - 20 are in the application. Reconsideration of the application, as amended, is requested.

Applicants thank Examiner Yevsikov for conducting a telephonic interview with Applicants' representative, undersigned, on May 2, 2003, and for his most helpful suggestions. A summary of the substance of the interview is included in these Remarks.

As a preliminary matter, and to complete the record, the Examiner's attention was drawn to the formal drawings, which were filed May 10, 2002; and to the corrected formal drawings, which accompanied the June 28, 2002 Preliminary Amendment. The Examiner indicated that the amendment to the drawings as reflected in the corrected formal drawings (changing a reference numeral 44 to 49 in Fig. 4) were Accepted.

The points raised in the Office action will now be addressed.

Drawings: Section 112 Rejections

The drawings were objected to under 37 CFR 1.83(a), the Examiner noting that the claim terms "substrate", "cavity" and "fill materials" were not particularly shown in the drawings.

Claims 6, 9, 10 and 13 were rejected under 35 U.S.C. § 112, ¶ 2, for indefiniteness, the Examiner asserting that the terms "substrate" and "fill materials" were confusing and not clear, and not distinctly disclosed.

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The drawings objection and the indefiniteness rejections are traversed. These terms, and the description of them in Applicants' specification, were discussed during the telephone interview; and the Examiner agreed that amendment of the drawings should not be necessary and the drawings objection and indefiniteness rejections would be withdrawn in view of Applicants' explanation, as summarized below.

As to the term "substrate", it was noted that the substrate is employed during manufacture of the package structure according to the invention, as part of a method for connecting the die to the leadframe, and that the substrate is discarded once the package has been made. Accordingly no "substrate" appears in the drawings because the drawings show various embodiments of package structures according to the invention, after the substrate has been discarded. The "substrate" is sufficiently described in paragraphs [0009], [0010] and [0034] of Applicants' specification. Particularly, as disclosed the substrate provides support for the leadframe for handling during the process steps. The leadframe is removably affixed to the substrate, which may have an adhesive surface. Suitable substrates for this purpose include, for example, a sheet or film such as an adhesive tape. By way of explanation, in making (for example) the package shown in Fig. 2, the substrate would have been removably affixed to the lower surfaces (as the package is oriented in the Fig.) of the projecting parts 20 of the leadframe 16. Following application of the fill material onto the substrate and connection of the chips to the lead fingers 22 by thermo-compression, the substrate would have been removed and discarded, to yield the completed package 10.

As to the term "cavity", it was noted that this term generally identifies the side of an integrated circuit chip (semiconductor die) onto which the die attach balls are affixed to make the package. Accordingly, for example, Applicants' Figs. 2, 3 and 4 illustrate "cavity-down" configurations, and Figs. 5 and 6 illustrate "cavity-up" configurations.

As to the term "fill material", mechanical support for the die attachment in a flip chip package is conventionally provided at least in part by an "underfill" formed on the cavity side of the die (*see*, Applicants' specification at paragraph [0011].) "Fill material" would accordingly be well understood by the skilled artisan and, in any event, it is sufficiently described in Applicants' specification, *e.g.*, at paragraphs [0010] and [0011]. According to some embodiments of the invention, a quantity of a "fill material" is dispensed onto the substrate and compressed between the die and the substrate as the die bumps are pressed against the lead fingers. In some

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embodiments the package is overmolded with a polymer (a "molding compound") to enclose the die and leadframe (*e.g.*, Applicants' paragraph [0034]) and, in some embodiments the fill material is itself a molding compound (*e.g.*, Applicants' paragraph [0011]).

In view of the foregoing, as the Examiner agreed in the interview, it is not necessary for an understanding of the subject matter of Applicants' invention (*see*, 35 U.S.C. §113) that the drawings show the "substrate" or the "cavity" or the "fill material"; and the drawings objection can be withdrawn.

And in view of the foregoing, as the Examiner agreed in the interview, the terms "substrate" and "fill material" are clearly and distinctly disclosed in Applicants' specification; and the Section 112 rejections for indefiniteness can be withdrawn.

Rejections under 35 U.S.C. § 102(b)

Claims 1 - 5 and 11 were rejected under 35 U.S.C. § 102(b) as being anticipated by Lin *et al.* U.S. 6,258,622 B1 ("Lin").

According to Applicants' invention the die is attached to the leadframe by thermo-compression of the bumps onto the bonding fingers of the leadframe (*see, e.g.*, Applicants' specification at paragraph [0005]). The thermo-compression method results in plastic deformation of the bump material (*see, e.g.*, Applicants' specification at paragraph [0009]), and avoids melting (or "reflow") of the bumps (or of any other structure) during the attachment. Accordingly, Applicants' invention avoids disadvantages of conventional methods employing solder bumps, particularly high cost and solder run-out. (*See, e.g.*, Applicants' specification at paragraph [0004].)

As Applicants' representative pointed out in the interview, Lin discloses attachment of an integrated circuit chip to a leadframe by reflow of solder bumps. (*See, e.g.*, Lin at Col. 3, lines 12-51, describing "solder bumps" on the chip, "solder-attachable metal layer" on the lead fingers of the leadframe, a "soldermask" with orifices at "positions where the lead fingers will connect with the solder bumps", and a "reflowing" step by which "the solder bumps are secured on the lead fingers of the leadframe".) (*See also, e.g.*, Col. 3, lines 52-67, describing melting of the solder-attachable metal layer, to reflow around the solder bump.)

Accordingly, Lin neither teaches nor suggests attachment of bumps on the die to the leadframe using a thermo-compression method, as in Applicants' invention. Claims 1 and 11 are

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amended herein to recite that no melting results from the heating step. The "without melting" term was agreed to by the Examiner as distinguishing Lin.

Rejections under 35 U.S.C. § 103(a)

Claims were variously rejected under 35 U.S.C. § 103(a) for obviousness: claim 14 and 15 over Lin in view of Kinsman U.S. 5,789,803 ("Kinsman '803"); claims 16 and 17 over Lin in view of Kinsman '803 and in view of Kinsman U.S. 6,172,419 B1 ("Kinsman '419"); and claims 18 and 19 over Lin in view of Kinsman '803, in view of Kinsman '419 and in view of Smith U.S. 6,441,488 B1 ("Smith").

Lin was applied as in the rejections under 25 U.S.C. § 102(b).

Kinsman '803 is relied upon as showing singulating (claims 14 and 15).

Kinsman '419 is relied upon as showing a "package wherein the die is situated cavity-upward or downward in relation to the set of bonding fingers."

Smith is relied upon as showing a "package wherein the leads fan inwardly or outwardly."

Attachment of die to leadframe by thermo-compression is not taught or suggested by any combination of the cited patents and, accordingly, none of the combinations makes Applicants' invention. Accordingly, the rejections for obviousness can now be withdrawn.

Claim 8 is amended to depend from amended claim 1. New claim 20, depending from amended claim 11, tracks the language of claim 7.

In view of the foregoing, all the claims now in the application are believed to be in condition for allowance, and action to that effect is respectfully requested.

This Amendment is being filed within the first month following the shortened statutory period set by the Examiner and, accordingly, it is accompanied by a Petition for one month's extension of time and a fee or fee authorization therefor. If the Examiner determines that a further extension of time is required in connection with the filing of this paper, petition is hereby made therefor, and the Commissioner is authorized to charge the fee to Deposit Account 50-0869 (Order No. CPAC 1001-1).

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Applicants again thank the Examiner for his assistance in the telephone interview. If the Examiner determines that a further conference would facilitate prosecution of this application, the Examiner is invited to telephone Applicants' representative, undersigned, at the telephone number set out below.

Respectfully submitted,



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